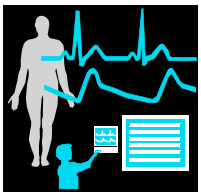
Philips M1013A/M1019A/M1026B



Instructions for Use

IntelliVue G1/G5 and Anesthetic Gas Module

M1013A/M1019A/M1026B

Patient Monitoring

PHILIPS

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1

Using the Gas Analyzer

The M1013A IntelliVue G1, the M1019A IntelliVue G5 and the M1026B Anesthetic Gas Module (AGM), hereafter referred to as the "gas analyzers", measure patients' anesthetic and respiratory gases.The following table shows the main features and the patient monitor compatibility for the three gas analyzers:

Gas Analyzer	Number of Gases measured	Number of Agents measured	Automatic Agent ID	Compatibility
M1013A IntelliVue G1	3	1	n/a	IntelliVue MP20/30/40/50
M1019A IntelliVue G5	3	2	2 out of 5	IntelliVue MP20/30/40/50/60/70/80/90
M1026B AGM	3	1	1 out of 5	IntelliVue MP40/50/60/70/80/90 and Philips ACMS; Philips V24/26

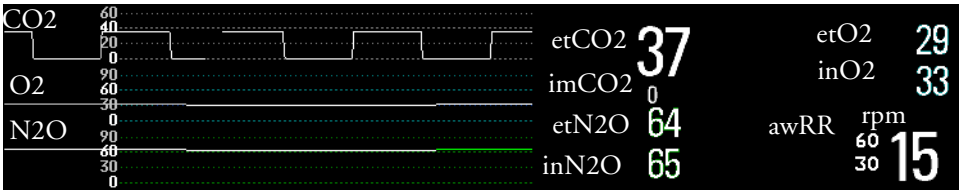
The gas analyzers measure the Airway Respiration Rate (awRR) and provide end tidal (et) and inspired (in) values for the following gases:

Respiratory Gases	Anesthetic Agents
Carbon dioxide (CO_2)	Halothane
Nitrous oxide (N_2O)	Isoflurane
Oxygen (O_2)	Enflurane
	Sevoflurane
	Desflurane

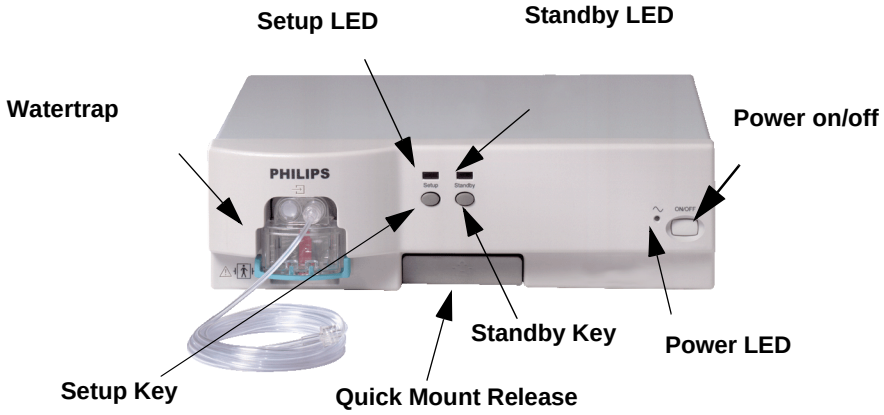
The gas analyzers must only be used by qualified personnel.

Understanding the Gas Analyzer Display

The gas analyzers can send waves and numerics for all measured gases for display on the monitor screen. This example shows the CO_2, O_2, and N_2O waves and numerics. Your display may be configured to look different.



M1013A IntelliVue G1 & M1019A IntelliVue G5 Major Parts and Keys



The setup LED lights when the **`Setup Gas Analyzer`** menu is open, when the module is first switched on (for 5 - 10 seconds), and if there is a problem with the communication between the gas analyzer and the monitor. The standby LED lights up when the gas analyzer is in standby.

M1013A IntelliVue G1 / M1019A IntelliVue G5 Rear Panel

The RJ-45 connector is the interface connector for the Philips IntelliVue patient monitors.

WARNING

- The M1013A IntelliVue G1 may only be used with the Philips IntelliVue MP20/30/40/50 patient monitors. Connections to other devices may result in a safety hazard.
- The M1019A G5 may only be used with the Philips IntelliVue MP20/30/40/50/60/70/80/90 patient monitors. Connections to other devices may result in a safety hazard.

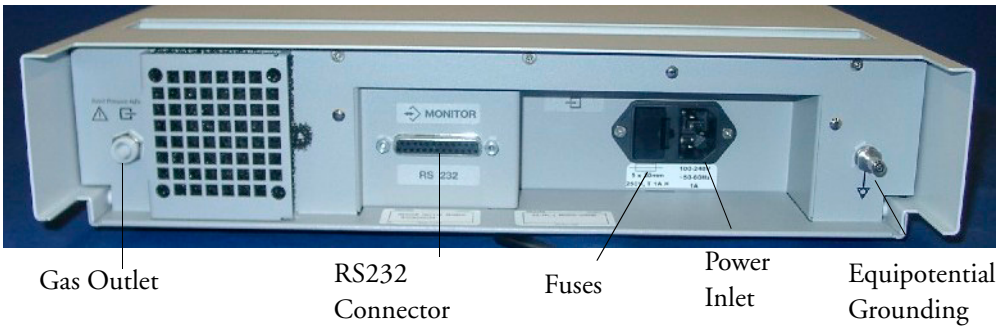
Make sure that the anesthetic gas outlet at the rear of the module is connected to the gas scavenging system or the gas return line.

See your gas analyzer's service guide for further information on connecting devices.

M1026B Major Parts and Keys

The setup airway gases LED lights when the **`Setup Gas Analyzer`** menu is open, when the module is first switched on (for 5 - 10 seconds), and if there is a problem with the communication between the M1026B and the monitor.

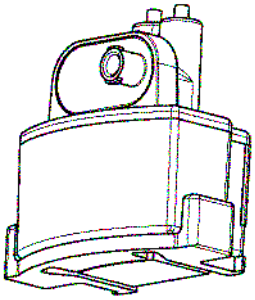
M1026B Rear Panel



Make sure all devices connected to the RS232 connectors are isolated. Make sure that the anesthetic gas outlet at the rear of the module is connected to the gas scavenging system or the gas return line.

See the M1026B Anesthetic Gas Module Service Guide for further information on connecting devices.

Watertrap M1657B



The watertrap prevents water and other fluids from passing into the gas analyzer and causing contamination and/or internal occlusions. It has a water reservoir in which fluids are collected, two water separation filters, and two shut-off fuses as a backup mechanism for the water separation filters.

The watertrap is for multi-patient use. It must be exchanged at least every two weeks or when watertrap is full.

Understanding the Gas Measurement

M1013A IntelliVue G1 & M1019A IntelliVue G5

The M1013A IntelliVue G1 and the M1019A IntelliVue G5 use a technique called Non-Dispersive Infrared Gas Concentration Measurement (NDIR) to measure the concentration of certain gases.

The gases which can be measured by the M1013A IntelliVue G1 and the M1019A IntelliVue G5 absorb infrared (IR) light. Each gas has its own absorption characteristic. The gas is transported into a sample cell, and an optical IR filter selects a specific band of IR light to pass through the gas. For multiple gas measurement, such as in the M1013A IntelliVue G1 or the M1019A IntelliVue G5, there are multiple IR filters. The higher the concentration of gas in a given volume the more IR light is absorbed. This means that higher concentrations of IR absorbing gas cause a lower transmission of IR light. The amount of IR light transmitted after it has been passed through an IR absorbing gas is measured. From the amount of IR light measured, the concentration of gas present can be calculated. This calculation provides the gas measurement value. Oxygen is measured by an additional sensor in the M1013A IntelliVue G1 and the M1019A IntelliVue G5 using its paramagnetic properties. The gas is transported into a sample cell. The higher the oxygen concentration, the higher the measured effect. The oxygen concentration can be calculated from the amplitude of the effect.

NOTE The presence of organic cleaning solutions or gases containing freon may impact the accuracy of the infrared gas measurement.

M1026B AGM

The M1026B Anesthetic Gas Module uses a technique called Dispersive Infrared (DIR) to measure the concentration of certain gases. The gases measured (except oxygen) by the M1026B Anesthetic Gas Module absorb infrared (IR) light. Each gas has its own absorption characteristic. The gas is transported into a sample cell. A diffraction grating is used to scan the relevant wavelength range of the IR light that passes through the sample cell. The higher the concentration of gas the more IR light is absorbed, and from the amount of IR light measured, the concentration of gas present can be calculated.

Individual gases have an individual spectral fingerprint. A mathematical algorithm is used to analyze the spectrum and to identify the anesthetic agents in the gas. Oxygen is measured by an additional sensor in the M1026B Anesthetic Gas Module using its paramagnetic properties. The gas is transported into a sample cell. The higher the oxygen concentration, the higher the measured effect. The oxygen concentration can be calculated from the amplitude of the effect.

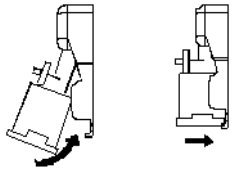
NOTE The presence of organic cleaning solutions or gases containing freon may impact the accuracy of the infrared gas measurement.

Connecting Gas Analyzer Accessories

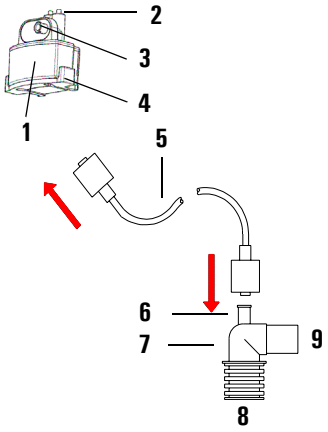
The gas analyzer accessories and part numbers are listed in the accessories section.

1 Insert the M1657B watertrap into the watertrap socket by gently pushing it up and in. Make sure that the watertrap snap lock clicks into place

2 Connect the gas sample tubing to the Luer connector of the watertrap.



3 Connect the other end of the gas sample tubing to the patient via the airway adapter.



1 M1657B Watertrap
2 Watertrap connector prongs
3 Luer connector (gas sample inlet)
4 Snap lock
5 M1658A Gas Sample Tubing
6 Gas sample port
7 Airway Adapter, *either*
13902A Elbow Airway Adapter
or M1612A Straight Airway Adapter
8 Connects to the patient
9 Connects to the Anesthesia Machine

WARNING Make sure that you do not accidentally connect the luer connector of the gas sample line to an infusion link or any other links in the patient vicinity.

CAUTION **Airway Adapter:** Use a Philips Airway Adapter listed in the Accessories section of this manual and position it so that the part connecting to the gas sample tube is pointing upwards. This prevents condensed water from passing into the gas sample tube and causing an occlusion. Philips airway adapters have a built-in port extending from the adapter wall, which reduces the risk of a blockage occurring.

Watertrap: To minimize the risk of internal contamination, never leave the gas analyzer running without a watertrap attached (except during a watertrap exchange).

Gas Sample Tube: Do not use the gas sample tube if it is kinked, as it may cause an occlusion or leakage.

Room Ventilation Make sure that the room in which the gas analyzer is used is well-ventilated with fresh air. Gases or fumes that mix with and contaminate the room air may degrade measurement accuracy. Use either a Gas Exhaust Return Filter/Gas Exhaust return Tubing to return gas samples to the breathing circuit or connect a scavenging system to the gas exhaust port and remove the gas sample. Note that Gas Exhaust return tubing may not be available for use in all geographies.

Do not use the gas analyzer in a hyperbaric chamber with oxygen enrichment. Also, the ambient air must be free of CO_2 enrichment.

WARNING Ensure that the connections are tight. Any leak in the system can result in erroneous readings due to ambient air mixing with patient gases.

Using the Gas Analyzer Setup Menus

Many gas analyzer settings can be changed just like other measurement settings. These are described in the chapter on Basic Operation in the Instructions for Use of your patient monitor, only gas analyzer-specific settings are described here.

To change settings for individual gases, enter the setup menu for the individual gas:

- select the measurement numeric on the monitor screen, or
- select the required gas label in the **`Setup <Gas Analyzer>`** menu.

To change Gas Analyzer settings, enter the **`Setup <Gas Analyzer>`** menu:

- select one of the gas analyzer numerics on the monitor screen and then select the menu item **`Setup <Gas Analyzer>`**, or press the Setup hardkey or Airway Gases hardkey on the gas analyzer.

Choosing Numerics for Display

For each gas the gas analyzer measures, you can choose which numerics are displayed with the waveform on the screen:

- **`et`** displays the endtidal numerics,
- **`in`** displays the inspiratory numerics,
- **`et+in`** displays both endtidal and inspiratory numerics.
- **`Off`** switches off measurement of that particular gas.

– **MAC** displays the minimum alveolar concentration of an anesthetic agent at which patients do not respond with movement to a painful stimulus.
– **MACawk** (MAC awake) displays the minimum alveolar concentration of an anesthetic agent at which patients respond to verbal command.

No waveforms or numerics will be shown for gases set to **Off**, and no alarms will be generated.

To change the displayed numeric, in the **Setup <Gas Label>** menu, select the label of the gas measured to call up a pop-up list of numerics available and then select the numeric you want to display.

As the inspired minimum is measured for CO_2 ($imCO_2$), the numeric label is **im** instead of **in**.

Humidity Correction for CO_2

The gas analyzer is configured to correct the CO_2 measurement for either Body Temperature Pressure Saturated (BTPS), to account for humidity in the patient's breath, or Ambient Temperature Pressure Dry (ATPD).

♦ In the **Setup CO2** menu, see the menu item **Humidity Corr.** to see which correction applies. It is either **Wet** for BTPS or **Dry** for ATPD.

Please refer to the Measurement Specifications in the Installation and Specifications chapter of this manual for details on the humidity correction.

Adjusting Wave Scales

1 In the **Wave** menu or the **Setup** menu for the gas, select **Scale**.
2 Choose a suitable scale range from the pop-up list.

Changing the Apnea Alarm Delay

The apnea alarm delay time determines the time limit after which the monitor alarms if the patient stops breathing.

1 In the **Setup CO2** menu, select **awRR**.

2 In the **Setup awRR** menu, select **Apnea Time**.

3 Choose the apnea alarm delay time.

WARNING The safety and effectiveness of the respiration measurement method in the detection of apnea, particularly the apnea of prematurity and apnea of infancy, has not been established.

Deriving Limit Alarms from awRR

1 In the **Setup CO2** menu or in the **Setup <Gas Analyzer>** menu, select **awRR**.

2 In the **Setup awRR** menu, select **Alarms**.

3 Select **On** to derive alarms from the airway respiration signal or **Off** to disable them.

Alarms and Zero Calibration

When a zero calibration is in progress, the physiological alarm detection is suspended. When the calibration is finished, the gas analyzer resumes alarm detection. If an alarm condition is present after the zero calibration, the alarm will be activated within the specified alarm delay time.

WARNING If an apnea occurs during a zero calibration, the time delay between the start of apnea and the activation of the apnea alarm could be up to 24 seconds plus the configured apnea delay time. After startup or after continuous operation of the **M1013A IntelliVue G1 or the M1019A IntelliVue G5** of 4 months or more the time delay could be up to 93 seconds plus the configured apnea time for a single time.

Automatic Alarm Suppression

Your monitor can be set to suppress alarms until it detects that a patient has been connected to the gas analyzer (when breathing is detected). This feature is called **No Al til Breath** and can be set to **On** or **Off** in the monitor's Configuration Mode.

Agent Identification

The following table shows the Agent Identification possibilities of the different gas analyzers:

Gas Analyzer	Manual Agent Identification	Automatic Agent Identification	Number of agents identified
M1013A IntelliVue G1	yes	no	n/a
M1019A IntelliVue G5	no	yes	2
M1026B AGM	yes	yes	1

NOTE Only the M1026B AGM allows switching the agent identification mode between **Agent Id: Manual** and **Agent Id: Auto**. Nevertheless, agent identification behavior for the M1013A IntelliVue G1 and the M1019A IntelliVue G5 is described below in the Manual Agent ID (M1013A) and the Automatic Agent ID (M1019A) sections.

Setting the agent identification mode to **Agent Id: Manual** lets you choose the anesthetic agent manually. If you choose the setting **Agent Id: Auto**, the gas analyzer automatically identifies the predominant anesthetic agent(s) in the breathing circuit.

- To change the agent identification mode, in the **Setup AGT** menu, select **Agent Id:** to toggle between the settings **Auto** and **Manual**.

If Agent ID is Set to Manual

To change the agent monitored, when **Agent Id** is set to **Manual**:

- In the **Setup <Agent label>** menu, select **Agent** to call up a pop-up list of available agents and select the agent you want to monitor. For example, **Setup HAL**.

M1026B only: If the manually selected agent does not match the agent detected, the INOP **CHECK AGENT** appears.

WARNING Make sure to select the correct agent for monitoring. Selecting the wrong agent will cause erroneous readings.

If Agent ID is Set to Auto (M1019A IntelliVue G5 & M1026B AGM)

As soon as the M1019A IntelliVue G5 or the M1026B AGM has detected the agent(s), a waveform and numerics for this agent appears on the monitor screen, if they are configured to be displayed. During the process of identification, the generic label **AGT** (**AGT1** and **AGT2** when using an IntelliVue G5) is shown as a placeholder.

For an anesthetic agent to be detected by automatic agent identification, its concentration must exceed the identification threshold. The presence of other substances in the patient's breathing circuit such as methanol or acetone can influence the agent identification and lead to incorrect values and incorrect identification.

Exchanging Agents (M1019A IntelliVue G5 & M1026B AGM)

If the anesthetic agent administered to the patient changes, a mixture of both gases is detected by the M1019A IntelliVue G5 or the M1026B AGM during the transition. The time needed to complete the exchange depends on the type of anesthesia (low flow or high flow), and the characteristics of the agents administered (pharmacokinetics). During the exchange, you will see the INOP message **AGT MIXTURE** and (with AGM only) **-?-** next to the affected numerics.

AGM only: If you are using automatic agent identification, when one of the agents decreases below its threshold and the other agent predominates, the monitor will recognize the exchange.

M1013A IntelliVue G1 and M1026B AGM only: If you are using manual agent identification, you must change the agent in the **Agent Setup** menu to match the administered agent.

Agent ID During Emergence from Anesthesia (M1019A IntelliVue G5 & M1026B AGM)

If automatic agent identification is selected during emergence from anesthesia and the agent concentration falls below the identification threshold, the agent will no longer be identified. The agent label will remain on the display and the numeric will show **0.00 %** (numeric unavailable with IntelliVue G5) until the monitor detects that a patient is no longer connected. After this, the generic label **AGT** (**AGT1 / AGT2** for M1019A IntelliVue G5) will be shown.

♦ To display the correct agent and value, change to manual identification and select the agent manually.(AGM only)

MAC Calculation

The MAC (Minimum Alveolar Concentration) value of an anesthetic gas or agent denotes the concentration at which 50% of a population of anesthetized patients do not respond with movement to a painful stimulus (e.g. a standardized incision through the skin). The MAC awake represents the concentration at which 50% of a population of anesthetized patients responds to verbal command.

The Philips IntelliVue patient monitors offer three configurable methods of MAC calculation:

- Uncorrected MAC
- Ambient Pressure Corrected MAC
- Enhanced MAC Correction

The preferred method must be set in configuration mode of your patient monitor. The total MAC and MACawk values can then be selected for display on your monitor. The sections below describe how these values are calculated with the different methods.

To switch the MAC and/or the MACawk parameter on, set MAC and /or MACawk to ON in the gas analyzer setup menu.

NOTE
- The MACawk value can only be displayed if MAC Correction is configured to “Enhanced”.
- MAC Calculation is only available in IntelliVue patient monitors with software revision C.0 or higher.
- Ambient Pressure Corrected MAC and Enhanced MAC Correction are not available in the USA.

Uncorrected MAC

If the MAC Correction is configured to “Off” the uncorrected MAC is calculated. The MAC value is not corrected for ambient pressure, age, temperature or any other individual factors influencing the effect of volatile anesthetic agents.

In order to calculate the MAC value the standard 1MAC concentrations of anesthetic agents and nitrous oxide are required. The following table lists these concentrations (according to the EN ISO 21647:2004 standard). The values are based on the assumptions that the patient is 40 years old (except for Desflurane where 25 years are assumed), the body temperature is 37° and the atmospheric pressure is 760 mmHg (1 atm):

Agent	Halothane	Enflurane	Isoflurane	Desflurane	Sevoflurane	N_2O
1MAC	0.77 vol%	1.7 vol%	1.15 vol%	7.3 vol%	2.1 vol%	105 vol%

For each volatile anesthetic agent detectable by the gas analyzer the MAC value for the specific agent (MAC(AA)) is calculated as follows:

$$MAC(AA) = \frac{etConc(AA)}{1MAC(AA)}$$

where AA = Anesthetic Agent and etConc = end-tidal concentration

In the same way, the MAC value for nitrous oxide (MAC(N2O) is derived from the measured value of the nitrous oxide end-tidal concentration (etConc(N2O)):

$$MAC(N2O) = \frac{etCONC(N2O)}{1MAC(N2O)}$$

Finally, the total MAC value of nitrous oxide and the selected anesthetic agent is calculated as follows:

$$MAC = MAC(N2O) + MAC(AA)$$

NOTE Gas components (N2O and/or anesthetic agent) which are switched off, are not included in the total MAC computation.

Ambient Pressure Corrected MAC (not available in the USA)

If the MAC Correction is configured to “Amb. Pressure”, the MAC is corrected to reflect the effect of a different partial pressure at another altitude.

The total MAC value is calculated in the same way as for the uncorrected MAC and then corrected for ambient pressure according to the following equation:

$$\text{MAC} = \text{uncorrected total MAC} \times \frac{\text{Pamb}}{760\ \text{mmHg}}$$

Enhanced MAC Correction (not available in the USA)

If the MAC Correction is configured to "Enhanced", the MAC value is corrected for age, temperature and ambient pressure.

The basic 1MAC values used for enhanced MAC Correction are listed in the table below.These values are taken from the scientific article *Age, minimum alveolar anaesthetic concentration and minimum alveolar anaesthetic concentration-awake* by Edmond I Eger II (Anesth Analg 2001, 93: 947-53)and differ slightly from the standard 1MAC values used for the uncorrected MAC.

NOTE There is no correction data available for Enflurane, so the standard 1MAC value is used in this case.

For standard conditions as assumed for the uncorrected MAC the values are:

Agent	Halothane	Enflurane	Isoflurane	Desflurane	Sevoflurane	N_2O
1MAC	0.757 vol%	no correction	1.19 vol%	6.45 vol%	1.8 vol%	114 vol%

The patient age can either be entered into the IntelliVue patient monitor, or provided by the information system if the monitor is networked. The patient temperature is obtained from a temperature measurement by the monitor. Only the following temperature labels are accepted for correction (listed in order of priority):

- Tcore
- Tblood

Patient Age Range:	1 to 100 years
Temperature Range:	25 to 45°C

Any age or temperature value outside the supported ranges is rounded to the according lower or upper boundary.

If the patient age is not available, the MAC correction will assume a default age of 40 years. If none of the listed temperatures is measured, a default temperature of 37°C is taken for MAC Calculation. In all of these cases the INOP "MAC CORRECTION?" is issued and the MAC numerics are marked questionable.

The 1MAC value for a specific potent inhaled anesthetic agent at age 40 (see table above) is corrected for patient age and temperature effects as follows (T given in degree Celsius and the age given in years):

$$1\text{MACcorr(AA)} = (1 - ((0.05) \times (37 - \text{T}))) \times 1\text{MAC(AA)} \times 1.32 \times 10^{-(0.00303 \times \text{Age})}$$

With the 1MAC value corrected for age and temperature at a standard pressure of 760mmHg, the MAC value of an anesthetic agent can be calculated as follows:

$$MAC(AA) = \frac{etConc(AA)}{1MACcorr(AA)}$$ (for all agents except Enflurane)

$$MAC(ENF) = \frac{etConc(ENF)}{1MAC(ENF)}$$ (for Enflurane)

The MAC value of nitrous oxide is obtained from the 1MAC concentration of nitrous oxide at age 40 corrected for the patient's age only (no correction is made for temperature):

$$MAC(N2O) = \frac{etConc(N2O)}{1MAC(N2O) \times 1.378 \times 10^{-(0.00347 \times Age)}}$$

The total MAC value for the combination of nitrous oxide plus the selected agent is obtained by adding the MAC value for the agent and the MAC value for nitrous oxide and correcting this sum for ambient pressure:

$$MAC = [MAC(N2O) + MAC(AA) \text{ or } MAC(ENF)] \times \frac{Pamb}{760\ mmHg}$$

NOTE Gas measurements which are switched off, are not included in the total MAC computation. The calculated MAC values for a 40 year old patient at a temperature of 37°C are similar but not identical to the 1MAC values given in the table for uncorrected MAC configuration.

In addition, the MAC_{awake} values can be determined as follows:

$$MACawk(AA) = \frac{MAC(AA)}{0.343}$$ (for all agents except Halothane)

$$MACawk(HAL) = \frac{MAC(HAL)}{0.551}$$ (for Halothane)

$$MACawk(N2O) = \frac{MAC(N2O)}{0.551} \text{ (for nitrous oxide)}$$

The total MACawk value is obtained by adding the indivdual MACawk values up:

$$MACawk = MACawk(N2O) + MACawk(AA) \text{ or } MACawk(HAL)$$

Removing Gas from the Circuit

If inhalation anesthetics are used during anesthesia, pollution of the operating room should be prevented by either returning the filtered gas sample to the breathing circuit (may not be available in all geographies) or by disposing of the gas sample.

Your hospital policy may not permit the use of gas return systems.

WARNING Make sure that you do not accidentally connect the luer connector of the gas sample line to an infusion link or any other links in the patient vicinity.

Returning the Gas Sample

NOTE Gas Sample Return may not be available in all geographies.

Use an M1656B Gas Exhaust Return Filter and M1655B Exhaust Return Tubing as instructed in the documentation supplied with the filter or the gas exhaust return line to return the gas sample to the patient's breathing circuit. Make sure the sample gas is routed through the CO_2 absorber before going back to the patient.

Removing the Gas Sample

To remove the gas sample from the breathing circuit, a scavenging system must be connected to the gas exhaust port. Use either:

- a gas exhaust scavenging tube
- a ventilator reservoir, where the suction pressure does not exceed 0.3-0.4mm Hg
- a scavenging interface.

CAUTION Make sure to compensate for any possible reduction of tidal volume caused by gas sampling.

Entering Gas Analyzer Standby Mode

During standby, the gas analyzer's gas sample intake pump and other internal components are automatically switched off to increase the lifetime of the device. The message **<GAS ANALYZER> STANDBY** is shown on the monitor. When you exit standby, you do not need to wait for the M1026B AGM to warm up to resume monitoring. The M1013A IntelliVue G1 and the M1019A IntelliVue G5 require up to 30 seconds warm up time before you can resume monitoring.

The gas analyzer standby mode is linked to the monitor standby mode:

- If the monitor enters standby mode, the gas analyzer also enters standby mode.
- If the monitor leaves standby mode, the gas analyzer automatically also leaves standby mode.
- If the gas analyzer enters or leaves standby mode, this does not affect the monitor.
- If the gas analyzer is disconnected from the monitor, it enters standby mode automatically after 3 to 5 minutes (M1013A IntelliVue G1 and M1019A IntelliVue G5 only).

The gas analyzer enters standby mode automatically when no breath is detected for a configured period of time (for M1026B AGM: if CO_2 is less than 4 mmHg, for M1013A G1 and M1019A G5: if CO_2 goes below adaptive threshold).

To enter or leave standby mode manually:

- in the **Setup <Gas Analyzer>** menu, select **Set to Standby** or **Exit Standby** or press the IntelliVue G1 or IntelliVue G5 Standby hardkey

Zero Calibration

The gas analyzer zero calibration maintains the accuracy of the gas measurements by sampling and analyzing room air. It takes about 15 to 21 seconds (M1013A G1 and M1019A G5) / 10 to 20 seconds (M1026B) to complete and may not be interrupted. If a zero calibration fails, a second zero calibration is performed automatically. The M1013A G1 and the M1019A G5 also attempt a third zero calibration if the second one fails. During the zero calibration, the waveform is flat and numerics are not updated. In case of apnea the numerics (except awRR) are marked *invalid* on the M1013A G1 and the M1019A G5, and in case of a zero retry they are marked *not available* on all gas analyzers.

NOTE After startup or continuous operation for 4 months of the **M1013A IntelliVue G1 and the M1019A IntelliVue G5** the zero calibration can take up to 93 seconds. If necessary, the zero calibration can be suspended for 5 minutes.

Automatic Zero Calibration

M1013A IntelliVue G1 and M1019A IntelliVue G5

A zero calibration is carried out automatically during warmup. After monitoring has been started zero calibrations are not performed more than every 2 hours. If the M1013A G1 or the M1019A G5 was in standby when one of the above triggers for zero calibration occurred, the zero calibration is carried out when the gas analyzer leaves standby. Typical zero time is 21 seconds. A longer zero calibration may occur if the M1013A G1 or the M1019A G5 is not switched off (i.e. running or in standby) for a longer period of time.

M1026B AGM

A zero calibration is carried out automatically after the module has been switched on, and then once every hour after monitoring has been started. If the M1026B was in standby when one of the above triggers for zero calibration occurred, the zero calibration is carried out when the M1026B leaves standby. Maximum zero time is 20 seconds.

Carrying Out Manual Zero Calibration

- To manually start a zero calibration, in the **Setup <Gas Analyzer>** menu, select **Zero Cal**, then select the **Confirm** pop-up key.

Suppressing Zero Calibration

To temporarily prevent an automatic zero calibration from being started,

- in the **Setup <Gas Analyzer>** menu, select **No Zero for 5min**.

Selecting **No Zero for 5min** again before the timer has timed out resets the timer to five minutes. This is not possible if a zero calibration is pending (automatic zero requested).

Using the Gas Analyzer During a Cardiopulmonary Bypass

CAUTION During a cardiopulmonary bypass, the anesthesiologist may cease periodic mechanical ventilation. In these cases, it is important to note that an active gas analyzer will continue to suck gases from the patient-ventilator circuit during that time. This will cause the airway pressure to drop if no active measures are taken to keep the patient-ventilator circuit stable.

To stop the gas analyzer from sucking gases out of the circuit, either:

- activate the gas analyzer standby mode or

disconnect the sample line from the gas analyzer or from the patient-ventilator circuit.

Safety Information

To avoid condensed water collecting in the gas sample tube, position the gas analyzer at or above the patient level. Do not set up the gas analyzer in a position where liquid could spill onto it.

WARNING **Detecting leaks:** Any leak in the tubing and connections from the patient to the gas analyzer may result in dilution of the gas mixture with ambient air. If this leak exceeds a certain magnitude, the value of gases and anesthetic agents displayed on the monitor may differ significantly from the actual concentration in the patient's breathing circuit. Erroneous values may lead to inappropriate intervention and patient safety may be at risk.

Unexpected values: If an unexpected gas concentration value appears on the monitor, or if the waves appear to be flatter than normal, visually inspect the entire tubing and replace if necessary. If no occlusion or leakage can be found, replace the watertrap with a new one and check the values.

CAUTION **Gas Analyzer ports:** Do not apply excessive pressure to the gas analyzer's inlet or outlet ports, for example from a syringe, as this may cause damage to the pneumatic and optical systems.

Cleaning: Switch off the gas analyzer during cleaning, as an intake of cleaning fluids or fumes may damage the device.

M1013A IntelliVue G1 and M1019A IntelliVue G5: Since the M1013A IntelliVue G1 and the M1019A IntelliVue G5 contain no internal bacterial filters never switch them on without a watertrap installed. Operating these gas analyzers without a watertrap may result in damage to the instrument.

WARNING

- Possible Explosion Hazard if used in the presence of flammable anesthetics.
- Do not use antistatic or conductive breathing tubes as they may cause burns in case of electrosurgery.
- Do not open the gas analyzer. Contact with exposed electrical components may cause electrical shock.
- Make sure that you do not accidentally connect the luer connector of the gas sample line to an infusion link or any other links in the patient vicinity.

2

Maintenance and Troubleshooting

WARNING **Schedule**: Failure on the part of the responsible individual hospital or institution employing the use of this equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards.

Contact: If you discover a problem with any of the equipment, contact your service personnel, Philips, or your authorized supplier.

Inspecting the Equipment and Accessories

You should perform a visual inspection before every use, and in accordance with your hospital's policy. With the gas anaylzer switched off:

1 Examine unit exteriors for cleanliness and general physical condition. Make sure that the housings are not cracked or broken, that everything is present, that there are no spilled liquids and that there are no signs of abuse.

2 Inspect all accessories (cables, transducers, sensors and so forth). If any show signs of damage, do not use.

Inspecting the Cables and Cords

Examine all system cables, the power plug and cord for damage. Make sure that the prongs of the plug do not move in the casing. If damaged, replace it with an appropriate Philips power cord.

Maintenance Task and Test Schedule

The following tasks are for Philips-qualified service professionals only. All maintenance tasks and performance tests are documented in detail in the Service Guide for your gas analyzer.

Ensure that these tasks are carried out as indicated by the gas analyzer's maintenance schedule, or as specified by local laws. Contact a Philips-qualified service provider if your gas analyzer needs a safety or performance test. Clean and disinfect equipment to decontaminate it before testing or maintaining it.

Maintenance and Test Schedule	Frequency
Safety checks according to IEC 60601-1	At least once every two years, or as needed, after any repairs where the power supply is replaced, or if the gas analyzer has been dropped.
M1013A IntelliVue G1 and M1019A IntelliVue G5 preventive maintenance and safety and performance assurance (SPA)	At least once a year or if you suspect the measurement values are incorrect.
M1026B AGM preventive maintenance	At least once every two years or if you suspect the measurement values are incorrect.
M1026B Safety and Performance Assurance (SPA)	At least once a year or if you suspect the measurement values are incorrect.
M1013A IntelliVue G1, M1019A IntelliVue G5 and M1026B AGM ventilator fan	Check at least every six months.

Troubleshooting

If you suspect a problem with the gas measurement, read the *Using the Gas Analyzer* chapter and doublecheck that you have set up the measurement correctly.

If you suspect an intermittent, system-wide problem call your service personnel.

Disposing of the Gas Analyzer

WARNING To avoid contaminating or infecting personnel, the environment or other equipment, make sure you disinfect and decontaminate the gas analyzer appropriately before disposing of it in accordance with your country's laws for equipment containing electrical and electronic parts. For disposal of parts and accessories, where not otherwise specified, follow local regulations regarding disposal of hospital waste.

You can disassemble the gas analyzer as described in the Service Guide for your gas analyzer.

- The top cover uses only one kind of steel.
- You can recycle the paper Instructions for Use.
- Dispose of accumulated fluids in the watertrap according to your local regulations and hospital policy.

Disposing of Empty Calibration Gas Cylinders

1. Empty the cylinder completely by pushing in the pin of the regulator valve or by pulling out the pin of the fill wave using a tire valve stem wrench or a pair of needle nose pliers.
2. When the cylinder is empty, either remove the valve stem from the fill (or regulator) hole, or drill a hole in the cylinder.
3. Write "Empty" on the cylinder and dispose of it appropriately for scrap metal.

WARNING Ensure that the cylinder is completely empty before trying to remove the valve stem or drill the tank.

3

Installation and Specifications

The specifications in this section apply to the M1013A IntelliVue G1, the M1019A IntelliVue G5 and the M1026B Anesthetic Gas Module (AGM).

The M1013A IntelliVue G1 and the M1019A IntelliVue G5 must be installed by qualified personnel. The M1026B AGM is not user installable and must be installed by qualified service personnel only.

Intended Use

The M1013A IntelliVue G1 and the M1019A IntelliVue G5 provide a non-dispersive infrared measurement of respiratory and anesthetic gases and a paramagnetic measurement of oxygen (Fast O_2).

The M1026B Anesthetic Gas Module provides a dispersive infrared measurement of respiratory and anesthetic gases and a paramagnetic measurement of oxygen (Fast O_2).

The M1013A IntelliVue G1 is designed to work with the Philips IntelliVue MP20/30/40/50 monitors, the M1019A IntelliVue G5 and the M1026B is designed to work with the Philips IntelliVue MP20/30/40/50/60/70/80/90 monitors. In addition the M1026B Anesthetic Gas Module is designed to work with the Philips ACMS and V24/V26 patient monitors. All gas analyzers are intended for measuring the airway gases of ventilated patients in health care facilities.

The M1013A IntelliVue G1, the M1019A IntelliVue G5 and the M1026B AGM are not therapeutic devices.

CAUTION U.S. Federal Law restricts this device to sale by or on the order of a physician.

Use only hospital grade power lines.

Do not store or operate the gas analyzer outside the storage and operating conditions specified in this chapter.

Do not expose the gas analyzer to excessive heat or sunlight as this could lead to overheating of the instrument and result in injuries.

Avoid any restriction or blockage of air flow as this could cause overheating of the gas analyzer and result in injuries.

Follow the mounting and installation instructions in your service guide closely to avoid injuries caused by the gas analyzer or of the device mounted on top of it falling down.

Mechanical vibrations or shock may have adverse effects on gas measurement values.

Manufacturer's Information

You can write to Philips at this address

Philips Medizin Systeme Boeblingen GmbH
Hewlett-Packard Str. 2
71034 Boeblingen
Germany

Visit our website at: www.philips.com.

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Responsibility of the Manufacturer

Philips considers itself responsible for any effects on safety, reliability and performance of the equipment only if:

- assembly operations, extensions, re-adjustments, modifications or repairs are carried out by persons authorized by Philips.
- the electrical installation of the relevant room complies with national standards.
- the instrument is used in accordance with the instructions for use.

To ensure safety, use only those parts and accessories specified for use with the M1013A IntelliVue G1, the M1019A IntelliVue G5 and the M1026B AGM. If other parts are used, Philips is not liable for any damage that these parts may cause to the equipment.

See your sales contract for product warranty information.

Symbols

These symbols appear on the gas analyzers:

Symbols		
Refer to accompanying documents	Setup*	Standby*
Power On/Off*	Equipotential grounding	2002-06 Identifies year and month of manufacture
Alternating current	Electrical input indicator	Electrical output indicator
Applied part has special protection against electric shocks (Type BF according to IEC 60601-1)and is defibrillator proof	Gas output indicator	Gas input indicator
Protective earth	RS-232 RS232 connector	Applied part has special protection against electric shocks (Type CF according to IEC 60601-1) and is defibrillator proof
CE 0366 The device complies with the requirements of the Council Directive 93/42/EEC of 14 June 1993 (Medical Device Directive).		

* These symbols are replaced by English text in the U.S.A.

Installation Safety Information

WARNING

- The M1013A IntelliVue G1 may only be used with the Philips IntelliVue MP20/30/40/50 patient monitors. Connections to other devices may result in a safety hazard.
- The M1019A IntelliVue G5 may only be used with the Philips IntelliVue MP20/30/40/50/60/70/80/90 patient monitors. Connections to other devices may result in a safety hazard.
- If multiple instruments are connected to multiple socket outlets, the sum of the enclosure leakage currents must not exceed the limits given in IEC/EN60601-1 and IEC 60601-1-1 respectively. Consult your service personnel.

NOTE The party assembling or modifying medical electrical units to install a medical electrical system or assembling or modifying electrical systems according to standard EN/IEC 60601-1-1 (safety requirements for medical electrical systems) is responsible for the compliance of all requirements of the standard.

Grounding	The M1013A IntelliVue G1, the M1019A IntelliVue G5 and the M1026B AGM must be grounded during operation. If a three-wire receptacle is not available, consult the hospital electrician. Never use a three-wire to two-wire adapter.
Equipotential Grounding	If the M1013A IntelliVue G1, the M1019A IntelliVue G5 or the M1026B AGM is used in internal examinations on the heart or brain, ensure that the room incorporates an equipotential grounding system to which the monitor and M1013A IntelliVue G1, M1019A IntelliVue G5 or M1026B AGM have separate connections.
Combining equipment	Combinations of medical equipment with non-medical equipment must comply with IEC 60601-1-1. Never use a multiple portable socket-outlet or extension cord when combining equipment unless the socket outlet is supplied specifically for use with that equipment.
Fusing	The monitor uses double pole/neutral fusing.

Installation Instructions

Please refer to the your gas analyzer's service guide for detailed installation instructions.

Altitude and Barometric Pressure

Altitude and barometric pressure affect gas measurements. The host monitor must be configured at installation to the correct altitude and the correct barometric pressure values for your hospital site. The gas analyzers measure barometric pressure with each zero calibration. If the barometric pressure measured by the gas analyzer differs by more than 60 mmHg from the monitor settings the INOP **`Zero Failed`** is issued to indicate that either the altitude setting is incorrect or the pressure sensor is defective. In the latter case, the conversions from concentration (vol%) to partial pressure (mmHg, kPa) may be erroneous.

M1013A IntelliVue G1 & M1019A IntelliVue G5 Specifications

Safety Specifications

The M1013A IntelliVue G1 and the M1019A IntelliVue G5 comply with:

IEC 60601-1:1988 + A1:1991 + A2:1995; EN60601-1:1990 + A1:1993 + A2:1995; UL 60601-1:2003; CAN/CSA C22.2#601.1-M90; IEC 60601-1-2:2001; EN 60601-1-2:2001.

Classification (according to IEC 60601-1): Class 1, Type BF, Continuous Operation.

This ISM device complies with Canadian ICES-001. Cet appareil est conforme a la norme NMB-001 du Canada.

The possibility of hazards arising from software errors was minimized in compliance with ISO14971:2000, EN60601-1-4:1996 + A1:1999 and IEC 60601-1-4:1996 + A1:1999

Physical and Electrical Specifications

Gas Analyzer	Weight	Size (H x W x D)
M1013A IntelliVue G1	< 4,5 kg < 9,92 lb	90 x 300 x 232 mm 3.54 x 11.81 x 9.13 in
M1019A IntelliVue G5	< 4,5 kg < 9,92 lb	90 x 300 x 232 mm 3.54 x 11.81 x 9.13 in

Power Consumption: peak: 45W, typical: 25W

Power Range 100 - 240 VAC

Sound Pressure: < 60 dB

If the M1013A IntelliVue G1 or the M1019A Intellivue G5 and its host monitor are without power for **less** than one minute, monitoring will resume with all active settings unchanged. If they are without power for more than one minute, the behavior depends on your configuration. If **`Automat. Default`** is set to **`Yes`**, the default profile will be loaded when power is restored. If **`Automat. Default`** is set to **`No`**, all active settings are retained, if power is restored within 48 hours. The **`Automat. Default`** setting is made in Configuration Mode of the patient monitor.

Environmental Specifications

The M1013A IntelliVue G1 and the M1019A IntelliVue G5 may not meet the performance specifications given here if stored or used outside the specified temperature and humidity ranges.

When the M1013A IntelliVue G1, the M1019A IntelliVue G5 and related products have differing environmental specifications, the effective range for the combined products is that range which is common to the specifications for all products.

Item	Condition	Range
Temperature Range	Operating	10 to 40 °C (50 to 104 °F)
	Non-operating	-20 to 65 °C (-4 to 149 °F)
Humidity Range	Operating	5 to 90% Relative Humidity (RH) max. @ 40 °C (104 °F) (non-condensing)
	Non-operating	5 to 95% Relative Humidity (RH) max. @ 65 °C (150 °F)
Altitude Range	Operating	-305 m to 2900 m (-1000 to 9515 ft)
	Non-operating	-305 m to 5000 m (-1000 to 16404 ft)
Atmospheric Pressure Range	Operating	70 kPa to 106 kPa
	Non-operating	50kPa to 106 kPa
Warmup Time		After switching on: 1 - 2 minutes to measure, 6 minutes for full accuracy

Measurement Specifications

Parameter	Item	Specification
CO_2	Range	0 to 76 mmHg
	Accuracy	±0.5 vol% or 12% relative, whichever is greater
	Resolution	1 mmHg
	Rise Time	350 msec typical
O_2	Range	5 to 100 vol%
	Accuracy	± 3 vol%
	Resolution	1 vol%
	Rise Time	500 msec typical
N_2O	Range	0 to 100 vol%
	Accuracy	2.0 vol% + 8% relative
	Resolution	1 vol%
	Rise Time	500 msec typical
Halothane **Enflurane** **Isoflurane** **Sevoflurane** **Desflurane**	Range	Halothane: 0 - 8.5 vol% Enflurane: 0 - 10.0 vol% Isoflurane: 0 - 8.5 vol% Sevoflurane: 0 - 10.0 vol% Desflurane: 0 - 20.0 vol%
	Accuracy	0.15 vol% + 15.0% relative
	Resolution	0.05
	Rise Time	500 ms typical
awRR	Range	0 to 60 rpm
	Accuracy	± 1 rpm
	Resolution	1 rpm
	Detection Criteria	adaptive threshold.

Accuracy specifications refer to BTPS for mmHg kPa and STPD for vol% at 40 - 60% relative humidity. All Performance and accuracy specifications are valid based on gas sample tubing M1658A, including watertrap M1657B, and airway adapter 13902A.

Humidity Correction: For CO_2 the humidity correction can be set to “wet” or “dry”.

Wet: p [mmHg] = c [Vol%] * (p_abs - p_H_2O)/100

Dry: p [mmHg] = c [Vol%] * p_abs /100

Where p = partial pressure, c = gas concentration, p_abs = pressure in breathing circuit, p_H_2O = 47 mmHg, partial pressure of water vapor of exhaled gas (37 °C, 100% rh).

For all other gases the readings are always given as dry values.

Sample Flow Rate: 200ml/min ±20 ml/min

Sample Delay Time: All measurements and alarms are subject to a delay of 5 seconds.

Total System Response Time = 5 + 0.5 seconds (sum of the delay time and rise time).

Leakage < 5ml/min

Air Ingression < 50ml per zero

The drift of measurement accuracy is automatically compensated by the auto zero calibrations.

IntelliVue G1/G5 Alarm Specifications	**High Limit Range**	**Delay**
etCO_2 High	20 to 76 mmHg (2.7 to 10.1 kPa)	19 seconds if no automatic zero calibration occurs within that time.
etCO_2 Low	10 to 75 mmHg (1.3 to 10.0 kPa)	
imCO_2 High	0 to 20 mmHg (0 to 2.7 kPa)	
inO_2 High	19 to 100 vol%	
inO_2 Low	18 to 99%	
inN_2O	0 to 82 vol%	
in/et HAL/ISO/ENF High	0.1 to 7.5 vol%	
in/et HAL/ISO/ENF Low	0.0 to 7.4 vol%	
in/et SEV High	0.1 to 9.0 vol%	
in/et SEV Low	0.0 to 8.9 vol%	
in/et DES High	0.2 to 20.0vol%	
in/et DES Low	0.0 to 19.8 vol%	
awRR High	Neonatal: 30 to 60 rpm Adult & Pediatric: 10 to 60 rpm	
awRR Low	0 to 55 rpm	settings < 20 rpm: less than 9seconds > 20 rpm: less than 19 seconds
Apnea delay	10 to 40 seconds	within 2 sec after alarm criterion (no detected breath within the adjusted delay time) is met, if no automatic zero calibration occurs.

IntelliVue G1/G5 Alarm Specifications	High Limit Range	Delay
IntelliVue G5 only:		
Agent ID Response Time		14 s for first agent, 19 s for second agent
First Agent Detection / Identification Threshold	All agents	max. 0.3 vol%
Second Agent Detection / Identification Threshold	All agents	max. 0.4 vol% of a second agent, except if a second agent is added to Desflurane, this causes a mixture identification at the latest if the concentration of the second agent exceeds 10 vol% of the current Desflurane concentration.

Interfering Gases and Vapours

At the gas levels listed below there is no influence on the specified accuracy of the M1013A IntelliVue G1 and the M1019A IntelliVue G5.

Gas or Vapour	Gas Level in % volume fraction
Nitrous Oxide	60
Halothane	4
Enflurane	5
Isoflurane	5
Sevoflurane	5
Xenon	Not for use with Xenon
Helium	50
Metered dose inhaler propellants	Not for use with metered dose inhaler propellants
Desflurane	15
Ethanol	0.3
Isopropanol	0.3
Acetone	0.1
Methane	3

M1026B Specifications

Safety Specifications

The **M1026B** complies with:

IEC 60601-1:1988 + A1:1991 + A2:1995; EN60601-1:1990 + A1:1993 + A2:1995; UL 60601-1:2003; CAN/CSA C22.2#601.1-M90; IEC 60601-1-2:2001; EN 60601-1-2:2001.

Classification (according to IEC 60601-1): Class 1, Type CF, Continuous Operation.

This ISM device complies with Canadian ICES-001. Cet appareil est conforme a la norme NMB-001 du Canada.

Physical and Electrical Specifications

Gas Analyzer	Weight	Size (H x W x D)
M1026B AGM	6.3 kg 13.9 lb	90 x 370 x 467 mm 3.54 x 14.5 x 18.4 in

Power Consumption: peak: 35W, typical: 25W

Power Range: 100 - 240 VAC

If the M1026B AGM and its host monitor are without power for **less** than one minute, monitoring will resume with all active settings unchanged. If they are without power for more than one minute, the behavior depends on your configuration. If **`Automat. Default`** is set to **`Yes`**, the default profile will be loaded when power is restored. If **`Automat. Default`** is set to **`No`**, all active settings are retained, if power is restored within 48 hours. The **`Automat. Default`** setting is made in Configuration Mode of the patient monitor.

Environmental Specifications

The M1026B AGM may not meet the performance specifications given here if stored or used outside the specified temperature and humidity ranges.

When the gas analyzers and related products have differing environmental specifications, the effective range for the combined products is that range which is common to the specifications for all products.

Gas Analyzer	Item	Condition	Range
M1026B AGM	Temperature Range	Operating	15 to 40 °C (59 to 104 °F)
		Non-operating	-20 to 65 °C (-4 to 149 °F)
	Humidity Range	Operating	Up to 95% Relative Humidity (RH) max. @ 40 °C (104 °F) (non-condensing)
		Non-operating	Up to 95% Relative Humidity (RH) max. @ 65 °C (150 °F)
	Altitude Range	Operating	-305 m to 3048 m (-1000 to 10 000 ft)
		Non-operating	-305 m to 5486 m (-1000 to 18 000ft)
	Atmospheric Pressure Range	Operating	70 to 106 kPa
		Non-operating	50 to 106 kPa
	Warmup Time		Full accuracy after selftest is finished (max. 2 min.)

Measurement Specifications

Parameter	Item	Specification
CO_2	Range	0 to 76 mmHg
	Accuracy	± 1.5 mmHg (0 - 30 mmHg) ± 5 vol % (30 - 76 mmHg)
	Resolution	1 mmHg
	Rise Time	410 msec typical
O_2	Range	0 to 100 vol%
	Accuracy	± 3 vol%
	Resolution	1 vol%
	Rise Time	640 ms typical
N_2O	Range	0 to 85 vol%
	Accuracy	±1.5 vol% + 5% relative
	Resolution	1 vol%
	Rise Time	510 msec typical
Halothane **Enflurane** **Isoflurane**	Range	0 - 7.5 vol%
	Accuracy	± (0.1 vol% + 4.0% relative)
	Resolution	0.05
	Rise Time	Halothane: <900 ms typical Enflurane < 620 ms typical Isoflurane < 610 ms typical
Sevoflurane	Range	0 - 9.0
	Accuracy	± (0.1 vol% + 4.0% relative)
	Resolution	0.05
	Rise Time	< 570 ms typical
Desflurane	Range	0 - 20.0
	Accuracy	± (0.1 vol% + 4.0% relative)
	Resolution	0.05
	Rise Time	< 540 ms typical
awRR	Range	0 to 60 rpm
	Accuracy	± 2 rpm
	Resolution	1 rpm
	Detection Criteria	6 mmHg variation in CO_2.
Agent ID Response Time		15 s typical
Agent Thresholds[1] for the primary halogenated anesthetic agent	HAL, ISO, ENF	0.20 vol%
	SEV	0.24 vol%
	DES	0.30 vol%
1. During warmup, the thresholds are three times the values listed.		

All Performance and accuracy specifications are valid based on gas sample tubing M1658A, including watertrap M1657B, and airway adapter 13902A.

Humidity Correction: For CO_2 the humidity correction can be set to “wet” or “dry”.

Wet: p [mmHg] = c [Vol%] * (p_abs - p_H_2O)/100

Dry: p [mmHg] = c [Vol%] * p_abs /100

Where p = partial pressure, c = gas concentration, p_abs = pressure in breathing circuit, p_H_2O = 47 mmHg, partial pressure of water vapor of exhaled gas (37 °C, 100% rh).

For all other gases the readings are always given as dry values.

Sample Flow Rate*:* 150 ml/min ±15 ml/min

Sample Delay Time: All measurements and alarms are subject to a delay of 3 seconds.

Total System Response Time = 3 + 0,64 seconds (sum of the delay time and the rise time).

The drift of measurement accuracy is automatically compensated by the auto zero calibrations.

AGM Alarm Specifications	Range	Adjustment	Delay
$etCO_2$ High	20 to 76 mmHg (2.7 to 10.1 kPa)	1 mmHg (0.1 kPa)	less than 18 seconds
$etCO_2$ Low	10 to 75 mmHg (1.3 to 10.0 kPa)		
$imCO_2$ High	2 to 20 mmHg (0.3 to 2.7 kPa)	1 mmHg (0.1 kPa)	
inO_2	90 to 800 mmHg 12 to 107 kPa 18 to 100 vol%	10 mmHg 1 kPa 1 vol%	
inN_2O	0 to 660 mmHg 0 to 88 kPa 0 to 82 vol%	10 mmHg 2 kPa 2 vol%	
in/et HAL/ISO/ENF	0 to 60 mmHg 0.0 to 8 kPa 0.0 to 7.5 vol%	1 mmHg 0.1 kPa 0.1 vol%	
in/et SEV	0 to 72 mmHg 0.0 to 9.6 kPa 0.0 to 9.0 vol%	1 mmHg 0.1 kPa 0.1 vol%	
in/et DES	0 to 160 mmHg 0.0 to 21.2 kPa 0.0 to 20.0vol%	2 mmHg 0.2 kPa 0.2 vol%	
awRR High	Adult/pedi: 10 to 60 rpm Neo: 30 to 60 rpm	under 20 rpm: 1 rpm over 20 rpm:5 rpm	
awRR Low	Adult/pedi: 0 to 55 rpm Neo: 0 to 55 rpm		settings < 20 rpm: less than 8 seconds > 20 rpm: less than 18 seconds
Apnea delay	15 to 40 seconds	5 second steps	set apnea delay time + 8 seconds

Interfering Gases and Vapours

At the gas levels listed below there is no influence on the specified accuracy of the M1026B AGM.

Gas or Vapour	Gas Level in % volume fraction
Nitrous Oxide	60
Halothane	4
Enflurane	5
Isoflurane	5
Sevoflurane	5
Xenon	Not for use with Xenon
Helium	Not for use with Helium
Metered dose inhaler propellants	Not for use with metered dose inhaler propellants
Desflurane	15
Ethanol	0.1
Isopropanol	0.1
Acetone	0.1
Methane	0.02

Safety and Performance Tests

You must observe any national regulations on the qualification of the testing personnel and suitable measuring and testing facilities. See the maintenance section for a list of required tests. Safety and performance tests, and what to do if the instrument does not meet these specifications are described in your gas analyzer's service guide.

Electromagnetic Compatibility (EMC) Specifications

CAUTION The M1013A IntelliVue G1, the M1019A IntelliVue G5 and the M1026B AGM are not intended for use with MRI.

Take special precautions regarding electromagnetic compatibility (EMC) when using medical electrical equipment. You must operate your monitoring equipment according to the EMC information provided in this book. Portable and mobile radio frequency (RF) communications equipment can affect medical electrical equipment.

Accessories Compliant with EMC Standards

All accessories listed in the accessories section comply with the requirements of IEC 60601-1-2:2001.

WARNING Using accessories other than those specified may result in increased electromagnetic emission or decreased electromagnetic immunity of the monitoring equipment.

Electromagnetic Emissions

The gas analyzers are suitable for use in the electromagnetic environment specified in the table below. You must ensure that they are used in such an environment

Emissions test	Compliance	Avoiding Electromagnetic Interference
Radio Frequency (RF) emissions	Group 1	The gas analyzers use RF energy only for their internal function. Therefore, their RF emissions are very low and are not likely to cause any interference in nearby electronic equipment
RF emissions CISPR 11	Class A	The gas analyzers are suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes
Harmonic emissions IEC 61000-3-2	n/a	
Voltage fluctuations IEC 61000-3-3	n/a	

WARNING

- The M1013A IntelliVue G1 can only be stacked with the IntelliVue MP20/30/40/50 patient monitors.
- The M1019A IntelliVue G5 can only be stacked with the IntelliVue MP20/30/40/50/60/70 patient monitors.

Electromagnetic Immunity

The gas analyzers are suitable for use in the specified electromagnetic environment. The user must ensure that they are used in the appropriate environment as described below.

Immunity test	IEC 60601-1-2 test level	Compliance level	Electromagnetic environment guidance
Electrostatic discharge (ESD) IEC 61000-4-2	± 6 kV contact ± 8kV air	± 6 kV contact ± 8kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	± 2 kV for power supply lines ± 1 kV for input/output lines	± 2 kV for power supply lines ± 1 kV for input/output lines	Mains power quality should be that of a typical commercial and/or hospital environment
Surge IEC 61000-4-5	± 1 kV differential mode ± 2 kV common mode	± 1 kV differential mode ± 2 kV common mode	Mains power quality should be that of a typical commercial and/or hospital environment
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	In close vicinity to this equipment, no equipment with extraordinary power frequency magnetic fields (power transformers, etc.) should be operated
Voltage dips and short interruptions on power supply input lines IEC 61000-4-11	<5% U_T (> 95% dip in U_T) for 0.5 cycles 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles < 5% U_T (> 95% dip in U_T) for 5 sec	<5% U_T (> 95% dip in U_T) for 0.5 cycles 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles < 5% U_T (> 95% dip in U_T) for 5 sec	Mains power quality should be that of a typical commercial and/or hospital environment. If the user of the monitor requires continued operation during power mains interruptions, it is recommended that the monitor is equipped with an internal battery or is powered from an uninterruptible power supply.
Conducted RF (IEC 61000-4-6)	150kHz - 80 MHz: 3 V/m	3 V/m	Recommended separation distance from portable and mobile RF transmitters with transmission power P[1] to this equipment including its lines: $1,2m \times \sqrt{P}$
Radiated RF (IEC 61000-4-3)	80 MHz - 2.5 GHz: 3 V/m	3 V/m	Recommended separation distance from portable and mobile RF transmitters with transmission power P[1] to this equipment including its lines: $1,2m \times \sqrt{P}$

In this table, U_T is the a.c. mains voltage prior to application of the test level.

[1] For P the highest possible “Equivalent isotropic radiated power” of the adjacent rf transmitter has to be inserted (value in Watt). Also in the vicinity of equipment marked with the symbol interference may occur. Field strengths from fixed, portable or mobile rf transmitters at the location of this equipment should be less than 3 V/m in the frequency range from 150 kHz to 2.5 GHz and less than 1 V/m above 2.5 GHz.

Recommended Separation Distance

The gas analyzers are intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or user of the gas analyzers can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment and the gas analyzers as recommended below, according to the maximum output power of the communications equipment.

Frequency of transmitter	**150 kHz to 80 MHz**	**150 kHz to 800 MHz**	**800 MHz to 2,5 GHz**
Equation	$d = 1,2\sqrt{P}$	$d = 1,2\sqrt{P}$	$d = 2,3\sqrt{P}$
Rated max. output power of transmitter (W)	**Separation distance (m)**	**Separation distance (m)**	**Separation distance (m)**
0.01	0.1	0.1	0.2
0.1	0.4	0.4	0.7
1	1.3	1.3	2.3
10	3.8	3.8	7.3
100	12.0	12.0	23.0

* 3 V/M distance to transmitters with frequencies from 150 kHz to 2.5 GHz, otherwise 1 V/m distance.

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Patient Alarms and INOPs

This chapter lists patient alarms and technical alarms (INOPs) generated by the gas analyzers in alphabetical order, irrespective of their priority.

Patient Alarm Messages

Alarm Message	Condition	Indication
*****APNEA** or *****APNEA xxx sec**	Respiration has stopped for longer than the preset apnea time. "xxx" denotes the Apnea duration.	numeric flashes, red alarm lamp, alarm tone.
****awRR HIGH**	The airway respiration rate has exceeded the high alarm limit.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone.
****awRR LOW**	The airway respiration rate has dropped below the low alarm limit.	numeric flashes and low limit is highlighted, yellow alarm lamp, alarm tone.
****et <Agent label> HIGH**	The end tidal agent high alarm limit has been exceeded.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone.
****et <Agent label> LOW**	The end tidal agent value has fallen below the low alarm limit.	numeric flashes and low alarm limit is highlighted, yellow alarm lamp, alarm tone.
****etCO2 HIGH**	The end tidal CO_2 high alarm limit has been exceeded.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone.
****etCO2 LOW**	The end tidal CO_2 value has fallen below the low alarm limit.	numeric flashes and low limit is highlighted, yellow alarm lamp, alarm tone.
****etO2 HIGH**	The end tidal O_2 high alarm limit has been exceeded.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone.
****etO2 LOW**	The end tidal O_2 value has fallen below the low alarm limit.	numeric flashes, and low limit is highlighted, yellow alarm lamp, alarm tone.
****imCO2 HIGH**	The inspired minimum CO_2 high alarm limit has been exceeded.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone.

Alarm Message	Condition	Indication
**in <Agent label> HIGH	The inspired agent high alarm limit has been exceeded.	numeric flashes, high limit is highlighted, yellow alarm lamp, alarm tone.
**in <Agent label> LOW	The inspired agent value has fallen below the AGT low alarm limit.	numeric flashes, low limit is highlighted, yellow alarm lamp, alarm tone.
**inN2O HIGH	The inspired N_2O high alarm limit has been exceeded.	numeric flashes, high limit is highlighted, yellow alarm lamp, alarm tone.
**inO2 HIGH	The inspired O_2 high alarm limit has been exceeded.	numeric flashes, high limit is highlighted, yellow alarm lamp, alarm tone.
**inO2 LOW	The inspired O_2 value has fallen below the low alarm limit.	numeric flashes, low limit is highlighted, yellow alarm lamp, alarm tone.
***inO2 LOW OXYGEN	The inspired O_2 value has fallen below 18 vol.%.	numeric flashes, low limit is highlighted, red alarm lamp, alarm tone.
**AGT MIX MAC>3	An agent mixture has been detected and the sum of the 2 agent MAC components + MAC (N_2O) is ≥ 3 MAC (uncorrected)	yellow alarm lamp, alarm tone

Technical Alarm Messages (INOPs)

INOP Message, Indication	What to do
<GAS ANALYZER> ACCURACY? Numerics shown with ?	Gas Analyzer measurement accuracy may be reduced. Check that the gas inlet, watertrap, and gas outlet tubing are not occluded. If this INOP persists, contact your service personnel.
<GAS ANALYZER> ALARM SUPPRESS	Gas Analyzer alarms will be suppressed until breathing activity is first detected.
<GAS ANALYZER> INCOMPATIBLE INOP tone	This version of the Gas Analyzer is not supported. Contact your service personnel.
<GAS ANALYZER> MALFUNCTION Numerics replaced by -?-, INOP tone, Gas Analyzer Setup LED may be blinking	There is a problem with the Gas Analyzer hardware. Check the connection to the monitor. Switch the Gas Analyzer off and then on again. If this INOP persists, contact your service personnel.
<GAS ANALYZER> NO BREATH et and in numerics show the same value	No breath detected. Check the patient connections.
<GAS ANALYZER> NOT AVAILABLE INOP tone.	The Gas Analyzer is either disconnected or switched off.
<GAS ANALYZER> OCCLUSION Numerics replaced by -?-, INOP tone	Make sure that the sample line and exhaust line tubing is not kinked. Check the airway adapter for a build up of water. Empty the fluid and reposition the adapter if necessary. Ensure that the airway adapter port is facing upwards. Try replacing the sample line, watertrap, or exhaust line. If this INOP persists, contact your service personnel.
<GAS ANALYZER> SELFTEST Numerics replaced by -?-	The Gas Analyzer selftest is running. Wait until this INOP disappears to start monitoring.
<GAS ANALYZER> STANDBY	To resume gas monitoring, select Exit Standby in the **Setup GA** menu.
<GAS ANALYZER> UNABLE TO MEAS Numerics replaced by -?-, INOP tone	The gas analyzer currently cannot measure <GAS>. If this INOP persists, contact your service personnel.
<GAS ANALYZER> ZERO FAILED Numerics shown with ?	A Gas Analyzer zero calibration failed. Check the exhaust tube for an occlusion or kinking and replace if necessary. Manually start another zero. If the zero has failed more than once, contact your service personnel.
<GAS ANALYZER> ZERO RUNNING First zero: numerics shown with ? (G1/G5 only: replaced by -?- if apnea), Second/Third zero: numerics are unavailable, INOP tone	Autozero in progress. If first auto zero fails then system will retry; if the retry fails then the **<GAS ANALYZER> ZERO FAILED** INOP is activated. **Note:** The IntelliVue G1 and IntelliVue G5 try 3 zeros before the INOP appears.
<GAS ANALYZER> SWITCHED OFF INOP tone	The gas analyzer has switched off all possible internal components due to overheating. Allow gas analyzer to cool down before resuming monitoring. If INOP persists contact your service personnel.
<GAS ANALYZER> WARMUP	The Gas Analyzer has not yet reached operating temperature and the measurement accuracy may be reduced.
<GAS ANALYZER> CHECK WATERTRAP INOP tone	The watertrap is full. Check that the sample line and/or watertrap is not disconnected
<GAS ANALYZER> COMPONENT MALF	A gas analyzer component is in malfunction. Some parameters may be unavailable or measured with reduced accuracy. Switch the gas analyzer off and then on again. If the INOP persists contact your service personnel.

INOP Message, Indication	What to do
AGENT CALCULATING	The gas analyzer is calculating the agent concentration. Wait until calculation is finished.
AGENT MIXTURE Numerics shown with ? or replaced by -?-, M1019A IntelliVue G5 may also show two valid numerics	The Gas Analyzer has detected more than one agent in the gas sample. Agent measurement accuracy is likely to be reduced when using the M1026B AGM.The measurement accuracy may be reduced when using the M1019A IntelliVue G5.
AGT ID MALFUNCTION Numerics replaced by -?-, INOP tone (in Auto mode)	There is a problem with the automatic agent identification. To continue monitoring, switch to manual agent selection. The Gas Analyzer numeric cannot reliably be derived. Contact your service personnel.
<AGT> CHANGE SCALE	The wave of the agent shown is clipped (DES/ENF/HAL/SEV/ISO). Select a more appropriate wave scale to display the whole wave.
AGT ID ZERO FAILED Numerics replaced by -?-, INOP tone (in Auto mode)	An automatic agent identification zero calibration failed. To continue monitoring, switch to manual agent selection. Contact your service personnel.
<AGT> MEAS DISTURBED Numerics replaced by -?-	The agent numeric cannot be reliably derived. If this INOP persists, contact your service personnel.
AGT MEAS RESTARTNG	The agent measurement is restarting. Wait until this INOP disappears before resuming monitoring.
AGT MEAS MALFUNCTION Numerics replaced by -?-, INOP tone	There is a problem with the agent measurement. Switch the gas analyzer off and then on again. If this INOP persists, contact your service personnel.
<AGT> OVERRANGE INOP tone	The <AGT> value is higher than the measurement range. If you suspect a false high value, contact your service personnel.
<AGT> UNABLE TO MEAS Numerics replaced by -?-, INOP tone	The Gas Analyzer currently cannot measure the agent shown (DES/ENF/HAL/SEV/ISO). If this INOP persists, contact your service personnel.
AWRR OVERRANGE Numerics shown with ?, INOP tone	The measured respiration rate is higher than the maximum measurable range.
CO_2 CHANGE SCALE	The CO_2 wave is clipped. Select a more appropriate wave scale to display the whole wave.
CO_2 OVERRANGE INOP tone	The CO_2 value is higher than the measurement range. If you suspect a false high value, contact your service personnel.
CO_2 UNABLE TO MEAS Numeric is replaced by -?-. INOP tone	The Gas Analyzer currently cannot measure CO_2. If this INOP persists, contact your service personnel.
MAC CHECK SOURCES INOP tone may appear	Either not all measurements or values required to perform the calculation are available or some of the required values are questionable. Check the measurement sources and make sure they are all switched on and that none of them are invalid or questionable.
MAC CORRECTION?	Enhanced MAC correction is on, but values for patient age and/or temperature are not available. Please enter these values.
N_2O CHANGE SCALE	The N_2O wave is clipped. Select a more appropriate wave scale to display the whole wave.
N_2O OVERRANGE INOP tone	There is a problem with the N_20 measurement. If this INOP persists, contact your service personnel.
N_2O UNABLE TO MEAS. Numerics replaced by -?-. INOP tone	The Gas Analyzer currently cannot measure N_2O. If this INOP persists, contact your service personnel.

INOP Message, Indication	What to do
O_2 CHANGE SCALE	The O_2 wave is clipped. Select a more appropriate wave scale to display the whole wave.
O_2 OVERRANGE INOP tone	There is a problem with the O_2 measurement. If this INOP persists, contact your service personnel.
O_2 UNABLE TO MEAS Numerics replaced by -?-. INOP tone	The Gas Analyzer currently cannot measure O_2. If this INOP persists, contact your service personnel.
O_2 ZERO FAILED Numerics replaced by -?-. INOP tone	An O_2 zero calibration failed. Contact your service personnel.

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Gas Analyzer Accessories

All accessories listed below may be used with the M1013A IntelliVue G1, the M1019A IntelliVue G5 and the M1026B AGM.

Description	Pieces per Pack	Part No.	Usage Time
Elbow Airway Adapter	20	13902A	single patient use
Straight Airway Adapter	20	M1612A	single patient use
Gas Exhaust Return Line	1	M1655A/B	multi-patient use
Gas Exhaust Return Filter	20	M1656A/B	single patient use
Watertrap	25	M1657B	multi-patient use, must be replaced every 2 weeks or sooner if full before.
Gas Sample Tube (2.6m)	20	M1658A	single patient use

NOTE M1655A and M1656A are not available in the USA and selected other countries. M1655B and M1656B in combination with the M1026B AGM are not available in the USA and may not be available in all other countries.

5 Gas Analyzer Accessories

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Care and Cleaning

Use only the Philips-approved substances and methods listed in this chapter to clean or disinfect your equipment. Warranty does not cover damage caused by using unapproved substances or methods.

Philips makes no claims regarding the efficacy of the listed chemicals or methods as a means for controlling infection. Consult your hospital's Infection Control Officer or Epidemiologist. For comprehensive details on cleaning agents and their efficacy refer to "Guidelines for Prevention of Transmission of Human Immunodeficiency Virus and Hepatitis B Virus to Health Care and Public-Safety Workers" issued by the U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, Atlanta, Georgia, February 1989. See also any local policies that apply within your hospital, and country.

General Points

Keep your gas analyzer, cables and accessories free of dust and dirt. After cleaning and disinfection, check the equipment carefully. Do not use if you see signs of deterioration or damage. If you need to return any equipment to Philips, decontaminate it first.

Observe the following general precautions:

- Always dilute according to the manufacturer's instructions or use lowest possible concentration.
- Do not allow liquid to enter the case.
- Do not immerse any part of the equipment in liquid.
- Do not pour liquid onto the system.
- Never use abrasive material (such as steel wool or silver polish).
- Never use bleach.

CAUTION If you spill liquid on the equipment or accessories, contact your service personnel or Philips service engineer.

Cleaning

Clean with a lint-free cloth, moistened with warm water (40°C/104°F maximum) and soap, a diluted non-caustic detergent, tenside, ammonia- or alcohol-based cleaning agent. Do not use strong solvents such as acetone or trichloroethylene. You may clean and disinfect the gas analyzer's gas exhaust return line (M1655B). Do not immerse or soak the tubing.

Do not allow water or cleaning solution to enter the connectors of the gas analyzer. Wipe around, not over, connector sockets.

Recommended cleaning agents are:

Tensides (dishwasher detergents)	Edisonite Schnellreiniger®, Alconox®
Ammonias	Dilution of Ammonia <3%, Window cleaner
Alcohol	Ethanol 70%, Isopropanol 70%, Window cleaner

Disinfecting

CAUTION **Solutions**: Do not mix disinfecting solutions (such as bleach and ammonia) as hazardous gases may result.

Hospital policy: Disinfect the product as determined by your hospital's policy, to avoid long term damage to the product.

Clean equipment before disinfecting. Recommended disinfecting agents are:

Alcohol based	Ethanol 70%, Isopropanol 70%, Cutasept®, Hospisept®, Kodan® Tinktur forte, Sagrosept®, Spitacid®, Sterilium fluid® (only Ethanol 70% and Isopropanol 70% are tested and qualified)
Aldehyde based	Cidex® activated dialdehyde solution, Gigasept (only Cidex is tested and qualified)

Gas Analyzer Accessories

Do not clean or disinfect the gas sample tube (M1658A), airway adapter (13902A or M1612A), or gas exhaust return filter (M1656B).

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